

Neehar Kondapaneni

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My current research interests are in **machine teaching** and **interpretability**, specifically, how can a fully-trained neural network be used to teach humans? This problem is challenging since we teach with respect to what a student knows, but what a student knows can only be estimated and changes as we teach. Broadly, I am interested in the differences between human cognition and machine cognition.

Education	California Institute of Technology PhD in Computation & Neural Systems	2018 - present
	University of California - San Diego B.S. Neuroscience and Physiology (Magna Cum Laude) Minor in Computer Science	2014 - 2017
Research Experience	Graduate Researcher (PhD) - Caltech Advisor: Dr. Pietro Perona	2018 - present
	<ul style="list-style-type: none">I am studying how the interpretability of neural network models and machine teaching may relate. In particular, how can we use an expert neural network to discover the important features of a class and subsequently use those features for teaching a human learner.	2022 - present
	<ul style="list-style-type: none">Proposed a novel problem for the computer vision community where a human learner's knowledge of a task is estimated while their understanding of the task changes as they are being taught the classes. I evaluated several methods on three new benchmark datasets that I developed and have published [Kondapaneni, 2022].	2021 - 2022
	<ul style="list-style-type: none">Studied the emergence of a generalizable numerosity estimator in an unsupervised neural network that mimics an embodied system. I found that the network learns a robust representation of up to 30 objects in spite of only being trained on 3 objects. Interestingly, the network shows subitization for ~6 objects, mirroring what is found in humans [Kondapaneni, 2020].	2020 - 2021
	<ul style="list-style-type: none">Developed an automated training environment for alternative forced choice (2-AFC) tasks in collaboration with the Meister Lab at Caltech. Built training boxes with touch screens. The mice were expected to touch one of two correct options on a screen in order to receive a reward. The task increased in difficulty as the mice improved.	2018 - 2019
	Undergraduate Researcher - UC San Diego Advisor: Dr. Pamela Reinagel <i>Modeled thirst mediated decision making behavior in rats.</i>	2017- 2018
	<ul style="list-style-type: none">Built a neuro-economic model to predict the likelihood a rat would drink water with respect to time, water consumed, and citric acid concentration in order to understand how task difficulty impacts water seeking behavior.	
	Undergraduate Researcher - UC San Diego Advisor: Dr. Takaki Komiyama <i>Studied motor learning in mice using wide-field calcium imaging.</i>	2014 - 2017
	<ul style="list-style-type: none">Designed a motor learning task for mice, built hardware and software to collect data, train mice, and analyze the neural recordings.	
	<ul style="list-style-type: none">Developed and implemented two algorithms (1) matched image annotations across image channels of a immunohistochemistry stain (2) parsed and annotated videos of mouse behavior.	

Preprints	A Number Sense as an Emergent Property of the Manipulating Brain Neehar Kondapaneni, Pietro Perona arXiv: 2012.04132	2021
Publications	Visual Knowledge Tracing Neehar Kondapaneni, Pietro Perona, Oisin Mac Aodha	2022
	Transformation of Cortex-wide Emergent Properties during Motor Learning Hiroshi Makino, Chi Ren, Haixin Liu, An Na Kim, Neehar Kondapaneni , Xin Liu, Duygu Kuzum, Takaki Komiyama	2017
Teaching	Selected Topics in Computational Vision (EE/CNS/CS 148) <ul style="list-style-type: none"> Gave an introductory lecture on transformers and how they are the basis to vision transformers. Covered the basics of attention and the intuition behind the formulation. Discussed the high-level differences between CNNs and ViT. Developed video tutorials for Amazon SageMaker and worked with the Amazon SageMaker EDU team to provide AWS credits for students and help them train their machine learning models. 	Sp 2021, Sp 2022
	SURF Mentor <ul style="list-style-type: none"> Mentored Daniel Israel (now attending UCLA for graduate school) in extending our work on generalizable numerosity representations. Guided Daniel through the relevant cognitive science, machine learning, and psychophysics literature. Worked with Daniel in choosing several important ablations studies for the model and helped him write new code to run them. Supported Daniel in developing his own novel questions and analysis to allow him to practice being an independent researcher. 	Sum 2021
Leadership	Pasadena Rent Control <ul style="list-style-type: none"> Collected petitions from voters in Pasadena to get a rent-control measure on the ballot. 	Oct 2021 - Mar 2022
	STEM Stall <ul style="list-style-type: none"> Hosted a stall at a farmer's market in a rural community (29 Palms, California). We created a demo on local rocks and minerals to open conversations on science. 	Feb 2022
	Freshman Summer Research Institute <ul style="list-style-type: none"> Jointly mentored an incoming freshman student on a computer vision research project. Taught the data management, building a neural network in PyTorch, and also discussed neural network intuition. 	Sum 2021
	Rise Tutoring <ul style="list-style-type: none"> Tutored an underprivileged high school student with a disability in mathematics and science. Taught concepts like fractions and slopes. 	2018 - 2020
Awards	Predoctoral Training in Quantitative Neuroscience (PTQN) Provost's Honor List Eureka! Scholarship Eagle Scout Award	2019 2014 - 2017 Summer 2016 2014